

CLAIMS

WHAT IS CLAIMED IS:

1. Ammunition (20; 320) for use with a discharging apparatus that includes a chamber for receiving the ammunition, a muzzle and a barrel between the chamber and the muzzle, the
5 ammunition comprising:
a case (22; 322) formed of zinc or a zinc-based alloy that extends aft-to-fore from a base to a mouth and has interior and exterior surfaces;
a propellant charge (26; 326) contained within the case; and
a member (24; 324) cooperating with the case to enclose the propellant charge, said
10 ammunition lacking a projectile having a mass in excess of a mass of the case.
2. The ammunition of claim 1 wherein the case (22; 322) is a unitary casting of a zinc alloy.
- 15 3. The ammunition of claim 1 wherein the case exterior surface (60; 360) has at least eight circumferential grooves (88; 388) said grooves occupying a total of at least about 25% of a length of the case.
4. The ammunition of claim 3 wherein the plurality of grooves (88; 388) have widths of
20 between 0.9mm and 1.8mm peak depths of between 0.08mm and 0.30mm from a maximum case diameter and, along with interspersed ungrooved areas extend along at least 70% of the case length.
5. The ammunition of claim 4 wherein said peak depths are between 0.13mm and 0.23mm
25 and said interspersed ungrooved areas have diameters within 0.05mm of the maximum case diameter.
6. The ammunition of claim 4 in combination with an industrial ballistic tool barrel (202) having rifling (210) with a land-to-land diameter which is 0.943-0.950in. (2.395-2.413cm) and
30 a groove-to-groove diameter which is 0.954-0.960in. (2.423-2.438cm).

7. The ammunition of claim 4 wherein the case exterior surface has circumferential extractor groove (50; 350) having a depth of at least 1mm and separated by no more than 2mm from an aft extremity of the case.

5 8. The ammunition of claim 1 further comprising a primer (28; 328).

9. The ammunition of claim 8 wherein the primer comprises a metallic cup mounted in the case base.

10. The ammunition of claim 9 wherein:

10 the primer is a #209 primer; and

the case has a mass of between 70g and 100g and a maximum diameter of between 20mm and 26mm.

11. The ammunition of claim 1 wherein the member (324) is a cap extending from a rear rim (369) to a front end (378) and having a rear portion encircling a fore portion of the case.

12. The ammunition of claim 11 wherein:

the cap (324) is formed of a resinous polymer;

the case fore portion includes a flange (366) having an external flange diameter;

the cap rear portion includes an inwardly directed part (368) aft of the flange (366) and having an internal diameter less than the flange diameter so as to cooperate with the flange to resist forward translation of the cap relative to the flange; and

a cap length is between 100% and 300% of a case length.

13. The ammunition of claim 12 wherein:

there is a first radial clearance of at least 1.0 mm between the flange (366) and the cap (324); and

there is a second radial clearance of between interference fit and 0.5 mm between the cap inwardly directed part (368) and a neck portion (364) of the case aft of the flange (366).

14. Ammunition (320) in combination with a discharging apparatus for firing such ammunition wherein:

the discharging apparatus comprises:

a chamber for receiving the ammunition;

a muzzle; and

a barrel between the chamber and the muzzle; and

5 the ammunition extends from a rear end to a front end and comprises:

a metallic case (322) that extends aft-to-fore from a base (336) at the ammunition rear end to a mouth (332) and has interior and exterior surfaces, the metallic case having a length and diameter effective to be initially accommodated within the chamber and then, after firing, to be driven forward into the barrel and discharged therefrom by such firing of a subsequent similar ammunition;

10 a cover (324) formed of polymeric resin and extending from a rear rim to a front end at the ammunition front end and having a mass not in excess of a mass of the case and having interior (372) and exterior surfaces (376); and

15 a propellant charge (326) confined within a volume at least partially defined by a combination of said case and said cover.

15. The combination of claim 14 wherein:

the case has a central longitudinal channel extending forward from a primer pocket portion at the base to a fore portion proximate the mouth;

20 a primer is mounted within the primer pocket; and

said volume is at least partially defined by the central longitudinal channel and the cover interior surface.

16. The combination of claim 14 wherein:

25 the cover has a cover length; and

the case has a case length, less than the cover length.

17. The combination of claim 14 wherein:

the cover consists essentially of injection molded high density polyethylene; and

30 the case consists essentially of die cast zinc or zinc alloy.

18. The combination of claim 14 wherein the cover interior surface (372) has a circumferential recess (374) forward of the case and effective to locally weaken the cover

sufficiently to permit internal pressure within the cover to sever a portion (375A) ahead of the recess from a portion (375B) behind the recess while the portion behind remains attached to the case when the ammunition is fired.

- 5 19. The combination of claim 18 wherein the circumferential recess:
has a longitudinal extent of between 1mm and 5mm; and
locally thins the cover to a minimum thickness of between 0.6mm and 1.4mm from an
adjacent thickness of between 1.6mm and 2.6mm.
- 10 20. The combination of claim 14 wherein:
the case has a mass of between 70g and 100g, a length of between 30mm and 40mm,
and a maximum diameter of between 20mm and 26mm;
the case exterior surface has a plurality of circumferential grooves (388), said grooves
occupying a total of at least about 25% of a length of the case.
- 15 21. The combination of claim 14 wherein:
the case consists essentially of zinc or a zinc-based alloy
- 20 22. A method for operating an industrial ballistic tool to discharge a plurality of
ammunition rounds, each having a case and a charge of propellant comprising:
(a) providing a plurality of such ammunition rounds each comprising a zinc case; ✓
(b) inserting a first such ammunition round into a chamber of the tool;
(c) causing ignition of the charge of the first ammunition round;
(d) inserting a second such ammunition round into the chamber; and
25 (e) causing ignition of the charge of the second ammunition round so as to expel the
spent case of the first ammunition round out of a muzzle of the tool at a muzzle kinetic energy.
- 30 23. The method of claim 22 further comprising:
repeating steps (d) through (e), each time utilizing a new ammunition round to expel the
case of the previously-discharged round.
24. The method of claim 22 further comprising:

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prior to insertion of the first round, inserting a chargeless case into the chamber so that the insertion of the first round advances the chargeless case toward the muzzle.

25. The method of claim 22 further comprising:

5 prior to insertion of the first round, inserting a preliminary round into the chamber, but not causing ignition of the charge of the preliminary round, so that the insertion of the first round advances the preliminary round toward the muzzle.

26. The method of claim 22 further comprising:

10 prior to insertion of the first round, inserting a preliminary round into the chamber and causing ignition of the charge of the preliminary round, so that the insertion of the first round advances the spent case of the preliminary round toward the muzzle.

27. The method of claim 22 wherein:

15 the muzzle kinetic energy is at least 10kJ.

28. The method of claim 22 wherein:

20 step (e) comprises permitting a first portion of a non-metallic cover portion of the second ammunition round to separate from a remaining second portion and travel behind the spent case of the first ammunition round to provide obturation; and

step (d) comprises engaging an aft end of the spent case of the first ammunition round with a fore end of the second such ammunition round so as to advance the spent case toward the muzzle.

25 29. The method of claim 22 wherein step (e) comprises:

permitting a first portion of a non-metallic cover portion of the second ammunition round to separate from a remaining second portion and travel behind the spent case of the first ammunition round; and

30 permitting the remaining second portion to seal against the chamber to resist combustion gas leakage around the case of the second round.

30. A method for operating an industrial ballistic tool to discharge a plurality of ammunition rounds, each having a case and a charge of propellant comprising:

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- (a) providing a plurality of ammunition rounds;
- (b) inserting a first such ammunition round into a chamber of the tool;
- (c) causing ignition of the charge of the first ammunition round;
- (d) inserting a second such ammunition round into the chamber, so as to advance the
5 spent case of the first ammunition round toward a muzzle of the tool; and
- (e) causing ignition of the charge of the second ammunition round so as to expel the
spent case of the first ammunition round out of the muzzle.

31. The method of claim 30 further comprising:
10 repeating steps (d) through (e), each time utilizing a new ammunition round to expel the
case of the previously-discharged round.

32. The method of claim 30 wherein said expulsion causes said spent case to at least one of:
15 impact adherent to remove such adherent from a surface; or
break open a furnace plug.

33. The method of claim 30 wherein said expulsion causes said spent case to at least one of:
knock a clinker from a kiln sidewall; or
break open a furnace plug.